

Directed and Elliptic Flow in Pb + Pb Collisions at the CERN SPS*

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The azimuthal anisotropy of charged particle emission from the interaction of a 158 GeV/nucleon Pb beam with a Pb target has been studied in the two main Time Projection Chambers (TPCs) of CERN SPS experiment NA49. The TPCs, situated downstream of two large dipole magnets, cover a large region of phase space forward of mid-rapidity. Identification of protons is performed by measurement of energy loss of the particles in the gas of the TPCs. This is the first study of directed and elliptic flow as a function of rapidity and transverse momentum for collisions of the heaviest nuclei at the highest bombarding energy presently available.

The data consist of 50k events taken with a medium bias trigger as determined by the NA49 veto calorimeter. It corresponds to an impact parameter selection of about 6.5 to 8.0 fm.

Event planes were determined for all the charged particles event-by-event and the

azimuthal distributions of the protons relative to these planes were fit to a Fourier expansion in terms of $\cos(\phi)$ and $\cos(2\phi)$, to obtain the observed directed and elliptic flow, respectively. The obtained values of the Fourier coefficients were then corrected for the resolution of the observed event planes relative to the real reaction planes to obtain v_1 and v_2 . These corrections were determined by the correlation of the planes of random subevents.

The rapidity dependence of the flow is shown in Fig. 1. The directed flow (v_1) values exhibit a characteristic S-shaped curve. The elliptic flow (v_2) values are in the plane of the directed flow and are peaked near mid-rapidity. It is thought that the elliptic flow retains a signature of the high density region created during the initial collision.

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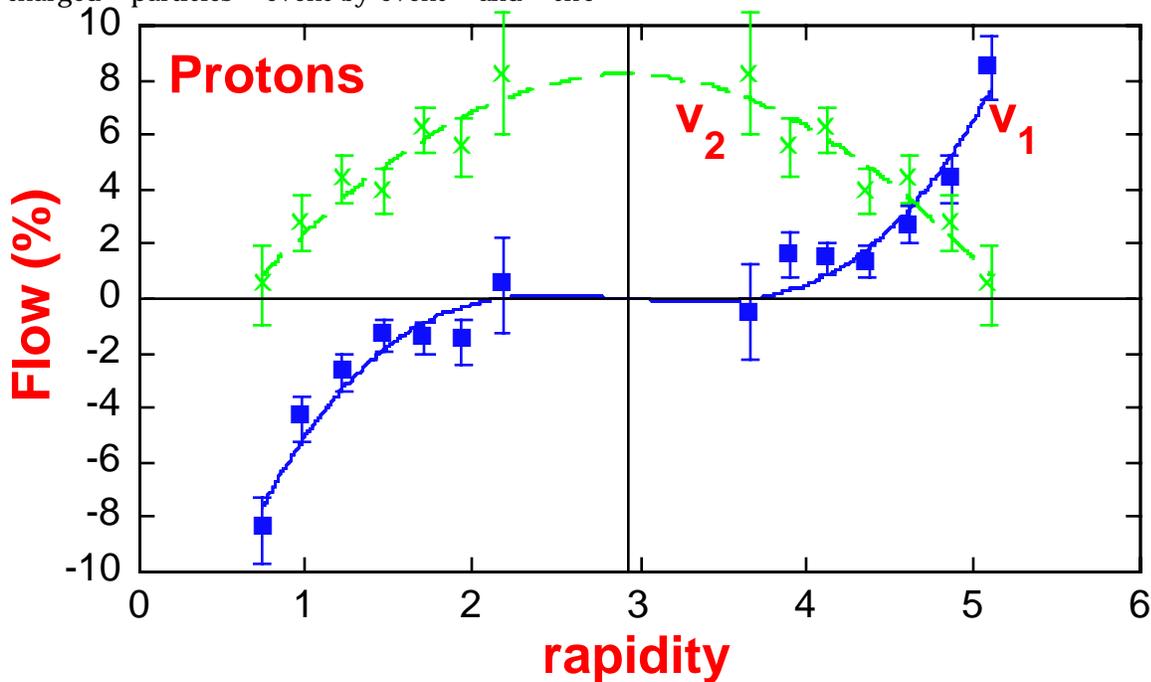


Fig. 1. The rapidity dependence of the directed (v_1) and elliptic (v_2) flow for the protons ($0.6 < p_t < 2.0$ GeV/c). The points below mid-rapidity ($y=2.92$) have been reflected from the measurements in the forward hemisphere. The curves are to guide the eye.